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## Adverse psychosocial working conditions and risk of severe depressive symptoms. Do effects differ by occupational grade?

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**Background:** Depression is a major concern for public health. Both adverse working conditions and low socio-economic position are suspected to increase risk of depression. In a representative sample of the Danish workforce we investigated (i) whether adverse psychosocial working conditions, defined by the effort–reward imbalance (ERI) model, predicted onset of severe depressive symptoms after 5-year follow-up and (ii) whether the effect of ERI was differential across occupational grades. **Methods:** A cohort of 2701 Danish employees filled in a questionnaire on work and health in 2000 and 2005. ERI was measured with four effort and seven reward items. Depressive symptoms were assessed with the five-item Mental Health Inventory. Participants scoring  $\leq 52$  points were defined as cases. We used logistic regression to investigate the association of ERI and occupational grade in 2000 with onset of severe depressive symptoms in 2005. Analyses were adjusted for socio-demographics, health behaviours, survey method, self-rated health, sleep disturbances and non-severe depressive symptoms at baseline. **Results:** High ERI predicted onset of severe depressive symptoms at follow-up, after adjustment for co-variables and occupational grade (OR = 2.19, 95% CI = 1.12–4.25). Participants with high ERI and low occupational grade showed a considerably higher OR (2.43, 95% CI = 1.07–5.53) compared to participants with low/medium ERI and low grade (OR = 1.45, 95% CI = 0.72–2.92), high ERI and high grade (OR = 1.26, 95% CI = 0.59–2.70) and low/medium ERI and high grade (reference group). **Conclusion:** Adverse psychosocial working conditions predicted onset of severe depressive symptoms. The effect was stronger among employees of lower occupational grades compared to those of higher grades.

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## Introduction

Depression has a high prevalence and is a major concern for public health in both high- and low-income countries.<sup>1</sup> The aetiology of depression is complex and multifactorial, involving biological, psychological and social factors.<sup>2,3</sup> Whereas occupational grade is an established predictor of depression,<sup>4</sup> evidence for the effect of adverse psychosocial working conditions is more sparse. Two recent reviews of the literature found that the dimensions of the demand–control–support model predicted depression in prospective studies.<sup>5,6</sup> However, both reviews pointed to a lack of studies investigating psychosocial working conditions other than those conceptualized by the demand–control–support model.

A theoretical conceptualization of the psychosocial work environment that might be of importance for depression research is the model of effort–reward imbalance at work (ERI-model). The model posits that a ‘high cost/low gain’ situation, in which individuals spend high effort while receiving low rewards (in terms of monetary gratification, career opportunities, esteem, respect and job security) elicits emotional distress, which consequently affects health.<sup>7</sup> The model has been most comprehensively tested with regard to risk of cardiovascular disease,<sup>8</sup> but has also been used to investigate risk of depression.<sup>9–12</sup> However, the effect of ERI on risk of depression has not yet been investigated in a representative sample of a national workforce.

It has been argued that the effect of adverse psychosocial working conditions on ill-health might be stronger in lower occupational grades,<sup>13</sup> however this hypothesis has rarely been tested. Employees of higher occupational grade might have more resources, both at work and outside work, which could buffer the effects of adverse working conditions. In the British Whitehall II study the effect of ERI on risk of myocardial infarction was considerably stronger among employees of lower occupational grade than among those of higher grade.<sup>14</sup> With regard to depression, we are not aware of any prospective study that has investigated differential effects of psychosocial work environment exposures by occupational grade.

The aims of the current study were: (i) To investigate the contribution of adverse psychosocial working conditions, conceptualized by the ERI-model, on risk of onset of severe depressive symptoms in a representative sample of the Danish workforce and (ii) to analyse whether the effect of ERI on risk of depressive symptoms is differential across occupational grades.

## Methods

### Study design and population

The Danish Work Environment Cohort Study (DWECS) is a longitudinal study on work and health in Denmark, initiated in 1990.<sup>15</sup> We have previously examined work environment exposures in DWECS 1995 and risk of severe depressive symptoms in DWECS 2000.<sup>16</sup> These analyses did not include ERI, as the construct was not included in 1995.

The present analyses are based on DWECS 2000 (baseline) and DWECS 2005 (follow-up). In 2000, a representative sample of 11 437 Danish residents was approached of which 8583 (75%) responded to the survey. Among the respondents, 4977 were gainfully employed with complete data on the ERI-measure. Of those, 3470 (70%) responded to the follow-up survey. We excluded 646 participants who were no longer gainfully employed and 68 participants with missing values on key variables. Finally, we excluded 55 participants who had severe depressive symptoms at baseline, defined by a score of  $\leq 52$  points on the five-item Mental Health Inventory (see details below), yielding a final study sample of 2701 participants, 1366 women and 1335 men. Mean (SD) age was 40 (9.4) years.

### Measurement of severe depressive symptoms

Severe depressive symptoms were assessed at baseline and at follow-up with the five-item Mental Health Inventory (MHI-5) from the Short-Form 36-item questionnaire.<sup>17</sup> The MHI-5 consists of five items on the frequency of depressive symptoms in the past 4 weeks. A complete list of the wording of each item is published elsewhere.<sup>16</sup> Responses were scored on a scale from 1 (‘all of the time’) to 6 (‘none of the time’). Scores were summed up and standardized, yielding a depressive symptom score ranging from 0 to 100, with higher scores indicating fewer symptoms. In accordance with the literature, we classified respondents scoring  $\leq 52$  points as cases of severe depressive symptoms.<sup>17,18</sup> We used the term ‘severe’, because previous analyses of DWECS showed that scoring below this cut-off point had severe consequences in terms of long-term sickness absence and disability pensioning.<sup>19,20</sup>

### Measurement of ERI

Because DWECS did not include the original ERI-questionnaire, we assessed effort and reward with proxy measures. A detailed report on the construction of the proxy measures and the wording of each item is published elsewhere.<sup>21</sup> We measured effort with four items (e.g. not having time to complete all work tasks) and rewards with seven items. The seven reward items included all three sub-dimensions of the reward concept in accordance to Siegrist and colleagues,<sup>7</sup> that is financial and status reward (two items, e.g. appropriateness of salary), esteem reward (three items, e.g. recognition and appreciation by management) and job security reward (two items, e.g. worried about becoming unemployed). We calculated an effort and a reward score by summing up the respective items and constructed an ‘ERI ratio’ with the effort score in the nominator and the reward score in the denominator.<sup>7</sup> The mean ERI-ratio was 0.54 with a SD of 0.18. For the purpose of analyses, we categorized the ERI-ratio into quartiles.

### Measurement of occupational grade

Employees were classified into occupational grades, according to job title, occupational position and education, yielding five categories: I, Executives/academics; II, Middle managers/advanced education; III, Other non-manual workers; IV, Skilled manual workers; V, Semiskilled/unskilled manual workers.

### Measurement of co-variables

We recorded gender, age, family status, current smoking, heavy alcohol consumption, leisure-time physical activity, self-rated health and sleep disturbances, because other studies have found them to be related with psychosocial work characteristics, mental health or both.<sup>4,21–26</sup> Full details of these variables are published elsewhere.<sup>15,21,26</sup> We also recorded whether the follow-up survey was administered as a questionnaire, a telephone interview, or on the internet. Furthermore, we included the continuous baseline MHI-5 score as a co-variate. Because participants with an MHI-5 score of  $\leq 52$  points were excluded, the MHI-5 score ranged from 53 to 100. We considered this score an indicator of non-severe depressive symptoms.

### Statistical analysis

We calculated odds ratios (OR) and 95% confidence intervals (CI) with multiple logistic regression models using ERI and occupational grade in 2000 as the predictors and onset of severe depressive symptoms in 2005 as the outcome. Co-variables were included in two models: Model 1 was adjusted for gender, age, family status, health behaviours and survey method. Model 2 was further adjusted for self-rated health, sleep disturbances and non-severe depressive symptom at baseline. ERI and occupational grade were adjusted for each other in both models.

Next, we calculated the prospective association of ERI and onset of severe depressive symptoms stratified by occupational grade. To improve statistical power, we collapsed the five occupational grades into three groups of high (grades I+II), medium (grade III) and low grade (grades IV+V).

Finally, we calculated odds ratios and Rothman's synergy index to estimate the joint effect of high ERI and low occupational grade.<sup>27</sup> We dichotomized ERI into low/medium *vs.* high and occupational grade into high (grades I+II) *vs.* low (grades IV+V). The intermediate occupational grade category III was omitted. The combination of ERI and occupational grade resulted in four groups: (1) low/medium ERI and high occupational grade (reference group); (2) low/medium ERI and low occupational grade ( $OR_A$ ); (3) high ERI and high occupational grade ( $OR_B$ ) and (4) high ERI and low occupational grade ( $OR_{AB}$ ). The synergy index (SI) was calculated with the formula:  $SI = (OR_{AB} - 1) / [(OR_A + OR_B) - 2]$ . An SI of 1 indicates perfect additivity and an SI of  $>1$  indicates a synergistic interaction as a departure of additivity.<sup>27</sup> CIs for the SI were calculated with the formula by Hosmer and Lemeshow.<sup>28</sup>

All analyses were conducted with the Stata/SE 12.1 statistical software (StataCorp LP, College Station, Texas, USA).

### Ethics approval

The study has been notified to and registered by the Danish Data Protection Agency (Datatilsynet). According to Danish law, studies that include data from questionnaires and from registers only do not need approval from the Danish National Committee on Biomedical Research Ethics (Den Centrale Videnskabetiske Komité).

## Results

At follow-up, 99 respondents (62 women and 37 men) had developed severe depressive symptoms, yielding an onset rate of 3.7% (4.5% and 2.8% for women and men, respectively).

### The relation of ERI and occupational grade

Figure 1 shows the relation between ERI and occupational grade at baseline. Employees in the highest occupational grade had the

highest (most unfavourable) ERI-ratio, whereas the lowest occupational grade had the lowest (most favourable). The Spearman correlation between ERI and occupational grade was  $\rho = 0.17$  ( $P < 0.001$ ). Participants of higher grade reported both more effort and more rewards than participants of lower grade. The relation between high occupational grade and high effort ( $\rho = 0.26$ ,  $P < 0.001$ ) was stronger than the relation between high occupational grade and high rewards ( $\rho = 0.11$ ,  $P < 0.001$ ). Patterns were similar among men and women (data not shown).

### ERI and occupational grade as predictors of severe depressive symptoms

Table 1 shows the prospective associations between ERI and occupational grade and risk of onset of severe depressive symptoms. There was a dose-response relation between ERI and risk of depressive symptoms, after adjustment for co-variables in model 1. Further adjustment attenuated effects (model 2), however, high ERI remained a statistically significant predictor. The association between ERI and onset of severe depressive symptoms was similar in women and in men (data not shown).

Odds of onset of severe depressive symptoms were elevated for participants of lower occupational grade, and in particular for manual workers. Results, however, were not statistically significant (table 1).

### ERI and risk of severe depressive symptoms, stratified by occupational grade

Table 2 shows the crude and adjusted odds ratio for the prospective association between ERI at baseline and risk of severe depressive symptoms, stratified by occupational grade. In the highest grade (I+II), there was no clear association between ERI and depressive symptoms, after adjustment for co-variables. However, in the medium grade (III) and in particular in the lowest grade (IV+V) there were indications of a dose-response relation between ERI and risk of severe depressive symptoms. The OR of onset of severe depressive symptoms for the highest ERI-quartile, compared to the lowest, was 1.30 in the analysis of grade I+II, 2.11 in the analysis of grade III and 4.08 in the analysis of grade IV+V.

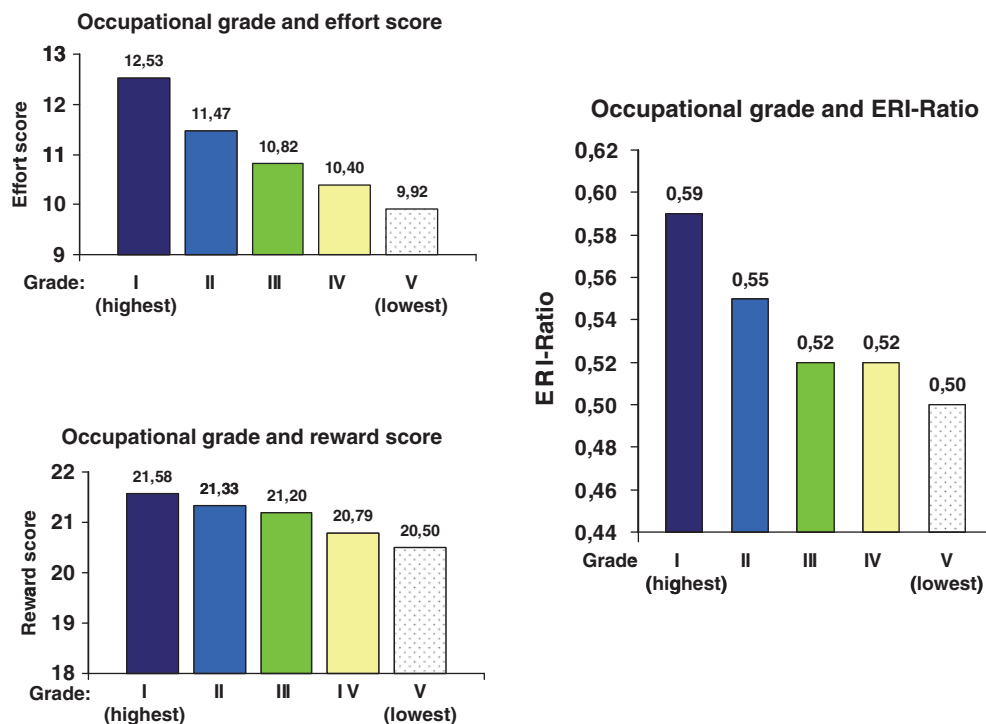


Figure 1 Effort and reward scores and ERI ratio by occupational grade in the Danish Work Environment Cohort Study 2000



**Joint effect of high ERI and low occupational grade**

Participants jointly exposed to high ERI and low occupational grade had a 3.46 (model 1) and 2.43 (model 2) increased risk of severe depressive symptoms compared to the reference group of

low/medium ERI and high occupational grade (table 3). The synergy index was 2.06 for model 1 (95% CI=0.48–8.78) and 2.01 for model 2 (95% CI=0.26–15.32).

**Discussion**

To our knowledge, this is the first prospective study demonstrating an effect of ERI on risk of severe depressive symptoms in a representative sample of a national workforce. Previously, prospective studies on ERI and depression have examined specific occupational groups, e.g. employees from selected Belgian companies,<sup>10</sup> public sector and hospital employees in Finland<sup>11</sup> and Swiss medical school graduates.<sup>12</sup> In concordance with the findings of the present study, ERI predicted clinical depression and depressive mood in these studies.

The ERI-ratio was more unfavourably distributed among the higher occupational grades. This may be surprising, because other well-known measures of adverse psychosocial working conditions, e.g. low job control, consistently have shown higher prevalences among employees of lower grades.<sup>29</sup> However, for ERI, data on the distribution across occupational grades is sparse, and the few available findings do not show a consistent pattern. In a German study, occupational grade did not show a clear association with ERI.<sup>30</sup> In the Whitehall II study, ERI was, in accordance with our findings, more prevalent among employees of higher grade.<sup>14</sup>

The scores of the reward scale were higher among higher occupational grades, as one would have expected, but the absolute differences between the grades were only modest. This might be explained by contextual factors. The follow-up period was a time of economic prosperity with low unemployment rates in Denmark,<sup>31</sup> probably resulting in high job security, also among employees of low grade. Moreover, Denmark had at the time of the baseline assessment the lowest level of income inequality of all OECD

**Table 1** ERI and occupational grade in 2000 and risk of onset of severe depressive symptoms in 2005 among 2701 employees from the Danish Work Environment Cohort Study

	At risk N	Cases N (%)	Model 1 OR (95% CI)	Model 2 OR (95% CI)
<b>ERI quartiles</b>				
Low ERI	684	14 (2.1)	1 (reference)	1 (reference)
Medium-Low ERI	669	22 (3.2)	1.75 (0.88–3.48)	1.55 (0.77–3.10)
Medium-High ERI	677	24 (3.6)	2.08 (1.05–4.09)	1.68 (0.85–3.34)
High ERI	671	39 (5.8)	3.50 (1.85–6.63)	2.19 (1.12–4.25)
Test for trend			<i>P</i> < 0.001	<i>P</i> < 0.02
<b>Occupational grade</b>				
I: Executives/academics	494	13 (2.6)	1 (reference)	1 (reference)
II: Middle managers	471	18 (3.8)	1.42 (0.68–2.99)	1.36 (0.64–2.91)
III: Other non-manual workers	972	37 (3.8)	1.52 (0.78–2.96)	1.60 (0.81–3.17)
IV: Skilled manual workers	349	14 (4.0)	2.06 (0.93–4.55)	2.08 (0.93–4.66)
V: Semiskilled/unskilled manual workers	415	17 (4.1)	1.94 (0.91–4.16)	1.95 (0.90–4.24)
Test for trend			<i>P</i> = 0.06	<i>P</i> = 0.05

Logistic regression analysis: Model 1: ERI and occupational grade are adjusted for each other and also for gender, age, family status, survey method and health behaviours (smoking, heavy alcohol consumption, leisure time physical activity); Model 2: further adjustment for self-rated health, sleep disturbances and non-severe depressive symptom score (53–100) at baseline

**Table 2** ERI in 2000 and risk of onset of severe depressive symptoms in 2005, stratified by occupational grade in 2000 among 2701 employees from the Danish Work Environment Cohort Study

	Executives/academics and middle managers (Grade I and II) <i>n</i> = 965			Low grade non-manual workers (Grade III) <i>n</i> = 972			Skilled/semiskilled/unskilled manual workers (Grade IV and V) <i>n</i> = 764		
	N/Cases	Crude OR (95% CI)	Adj. OR (95% CI)	N/Cases	Crude OR (95% CI)	Adj. OR (95% CI)	N/Cases	Crude OR (95% CI)	Adj. OR (95% CI)
<b>ERI quartiles</b>									
Low ERI	174/4	1	1	272/7	1	1	238/3	1	1
Medium-Low ERI	237/8	1.48 (0.36–4.55)	1.28 (0.36–4.55)	232/7	1.18 (0.41–3.41)	1.28 (0.43–3.84)	200/7	2.84 (0.72–11.13)	2.99 (0.73–12.18)
Medium-High ERI	241/5	0.90 (0.19–3.15)	0.78 (0.19–3.15)	263/10	1.50 (0.56–3.99)	1.60 (0.58–4.43)	173/9	4.30 (1.15–16.12)	3.82 (0.95–15.41)
High ERI	313/14	1.99 (0.38–4.46)	1.30 (0.38–4.46)	205/13	2.56 (1.00–6.54)	2.11 (0.76–5.86)	153/12	6.67 (1.85–24.03)	4.08 (1.02–16.24)
Test for trend		<i>p</i> = 0.27	<i>p</i> = 0.80		<i>p</i> = 0.04	<i>p</i> = 0.14		<i>p</i> = 0.001	<i>p</i> = 0.05

Logistic regression analysis: ERI is adjusted for gender, age, family status, survey method, health behaviours (smoking, heavy alcohol consumption, leisure time physical activity), self-rated health, sleep disturbances and non-severe depressive symptom score (53–100) at baseline

**Table 3** Joint effect of ERI and occupational grade in 2000 on risk of onset of severe depressive symptoms in 2005 among 1729 employees of either low or high occupational grade from the Danish Work Environment Cohort Study

	At risk N	Cases N (%)	Model 1 OR (95% CI)	Model 2 OR (95% CI)
<b>Combination of ERI and Occupational Grade</b>				
Low/Medium ERI & high grade (I+II)	652	17 (2.6)	1 (reference)	1 (reference)
Low/Medium ERI & low grade (IV+V)	611	19 (3.1)	1.36 (0.68–2.71)	1.45 (0.72–2.92)
High ERI & high grade (I+II)	313	14 (4.5)	1.83 (0.88–3.81)	1.26 (0.59–2.70)
High ERI & low grade (IV+V)	153	12 (7.8)	3.46 (1.56–7.68)	2.43 (1.07–5.53)

Logistic regression analysis: Model 1: Analysis adjusted is for gender, age, family status, survey method and health behaviours (smoking, heavy alcohol consumption, leisure time physical activity); Model 2: further adjustment for self-rated health, sleep disturbances and non-severe depressive symptom score (53–100) at baseline

countries,<sup>32</sup> probably resulting into a relatively weak effect of grade on financial reward.

Although ERI was more unfavourably distributed among employees of higher grade, it had a stronger effect on onset of severe depressive symptoms among employees of lower grades. Previously, Wege *et al.* reported similar results in a sample of German residents, however, their study was cross-sectional and therefore limited in drawing causal inference.<sup>30</sup>

Why is an adverse psychosocial work environment more harmful in lower than in higher occupational grades? One explanation is that employees of higher grades have better psychosocial resources at work, for example higher job control,<sup>29</sup> helping to counterbalance the adverse effect of ERI. Employees of higher grades might also have more access to resources outside of work, for example recreational possibilities, which could buffer the effect of adverse working conditions.

Similar working conditions might also be experienced differently across occupational grades. Lack of promotion prospects or an inappropriate salary might be more hurtful at the lower end of the social hierarchy than at the higher end. Job insecurity could be more threatening for employees of lower grades, because it would be more difficult for them to find a new job compared to employees of higher grades. This is in line with previous findings from Denmark showing that the effect of job insecurity on self-rated health is modified by perceived chances on the labour market.<sup>33</sup>

### Methodological considerations

Reporting bias is an important concern, in particular when exposures and endpoints are assessed by common methods.<sup>34</sup> In this article, reporting bias could have caused an overestimation of the true effect, if undetected depressive symptoms at baseline both had caused over-report of exposure at baseline and onset of the endpoint at follow-up. To address this problem, we adjusted our analyses for a non-severe depressive symptom score at baseline. Furthermore, we controlled for poor self rated health and sleep disturbances that could have influenced both reporting of ERI at baseline and onset of severe depressive symptoms at follow-up. However, some of these adjustments might be over-adjustments. Sleep disturbances, for example, could be a confounder (if sleep disturbances caused both ERI at baseline and depressive symptoms at follow-up) or an intermediate step in the pathway (if ERI caused sleep disorders and sleep disorders caused depressive symptoms). In table 1 we presented analyses both without (model 1) and with (model 2) adjustment for self-rated health, sleep disturbances and non-severe depressive symptom score. The odds ratios in model 1 might be vulnerable to reporting bias and thus overestimate the effect of ERI, whereas the odds ratios in model 2 might be over-adjusted and thus underestimate the true effect.

It has been argued that social disadvantage is often closely related to both exposure to adverse working conditions and to onset of poor health.<sup>35</sup> In this article, however, adverse working conditions were associated not with social disadvantage but with social advantage. Consequently, the effect of ERI on depressive symptoms became stronger and not weaker after adjustment for occupational grade. Thus, in this article, residual confounding by occupational grade due to imprecise measurement of this variable would not bias the odds ratios towards an overestimation but towards an underestimation.

We excluded participants who were no longer employed at follow-up. This was motivated by the consideration that leaving the active workforce is a major life event with a potential strong effect on mental health. Whereas involuntary exclusion from the labour market might increase risk of ill-mental health,<sup>36</sup> voluntary leaving might improve mental health.<sup>37</sup>

### Strengths and weaknesses of the study

The use of a representative cohort of a national workforce and the prospective design are strengths of the study. The results are not restricted to a specific industry or specific occupational groups but can be generalized to the Danish workforce.

We defined exposure to adverse psychosocial working conditions based on a well-established theoretical model. As delineated in the introduction, two recent reviews have called for testing psychosocial models other than the demand-control-support model in depression research, a call to which we responded with the present study. By stratifying the analyses by occupational grade, we attempted to contextualize the effect of psychosocial working conditions, which, we believe, is important, given the complex, multifactorial aetiology of depression.<sup>2,3</sup>

These strengths of the study need to be balanced against its weaknesses. It would have been preferable to measure depressive symptoms with the gold standard method, a clinical diagnostic interview. However, we are confident that the MHI-5 is a valid instrument for measuring depressive symptoms. In a clinical study, the MHI-5 showed good sensitivity and specificity for identifying clinical diagnoses of depression.<sup>38</sup> The MHI-5 performed less well in identifying other psychiatric diagnoses. Furthermore, two studies comparing the MHI-5 with other diagnostic instruments found that the MHI-5 has a good validity for measuring depressive disorders.<sup>17,18</sup>

The long follow-up is a limitation. We were able to identify cases of severe depressive symptoms at baseline and at the time of the follow-up, but we lost all cases that had an onset during the 5-year follow-up and were in remission at the time the follow-up questionnaire was distributed. Moreover, working conditions may have changed during the follow-up, resulting in non-differential misclassification of the exposure and an underestimation of the effects.

The number of cases in the study was low resulting into wide CIs when we stratified by occupational grade and calculated the synergy index. Moreover, the low number of cases did not allow stratification by gender. The findings therefore need to be viewed with caution. Studies with larger samples are needed to achieve more precise results and to investigate whether effect modification of the impact of ERI on depressive symptoms by occupational grade might be different in women and men. This might be achieved by combining datasets from different work and health cohorts.<sup>39,40</sup>

### Conclusion

Adverse psychosocial working conditions, defined by the ERI-model, predicted onset of severe depressive symptoms in a representative sample of the Danish workforce. The effect was stronger among employees of lower occupational grades compared to those of higher grades. Interventions aiming to reduce risk of depression via improvements of psychosocial working conditions seem to be especially needed in job groups of lower occupational grade.

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## Key points

- Depression has a high prevalence and constitutes a major concern for public health in both high- and low-income countries
- The aetiology of depression is regarded as complex and multifactorial and may involve both adverse psychosocial working conditions and low socio-economic position
- In this representative sample of the Danish workforce, participants reporting an imbalance between high efforts and low rewards at work were at increased risk of onset of severe depressive symptoms after 5 years of follow-up
- The prospective association between adverse psychosocial working conditions and risk of severe depressive symptoms was more pronounced among participants of lower occupational grade compared to those of higher grades
- Interventions aiming to reduce risk of depression via improvements of psychosocial working conditions seem to be especially needed in job groups of lower occupational grade

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